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Potters

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[54] **PRESS FIT CIRCUIT BOARD CONNECTOR**

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[73] Assignee: **Berg Technology, Inc.**, Reno, Nev.

[*] Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

[21] Appl. No.: **08/804,717**

[22] Filed: **Feb. 21, 1997**

[51] **Int. Cl.**[7] **H01R 12/00**

[52] **U.S. Cl.** **439/79**

[58] **Field of Search** 439/79, 80, 608, 439/595, 733.1, 108

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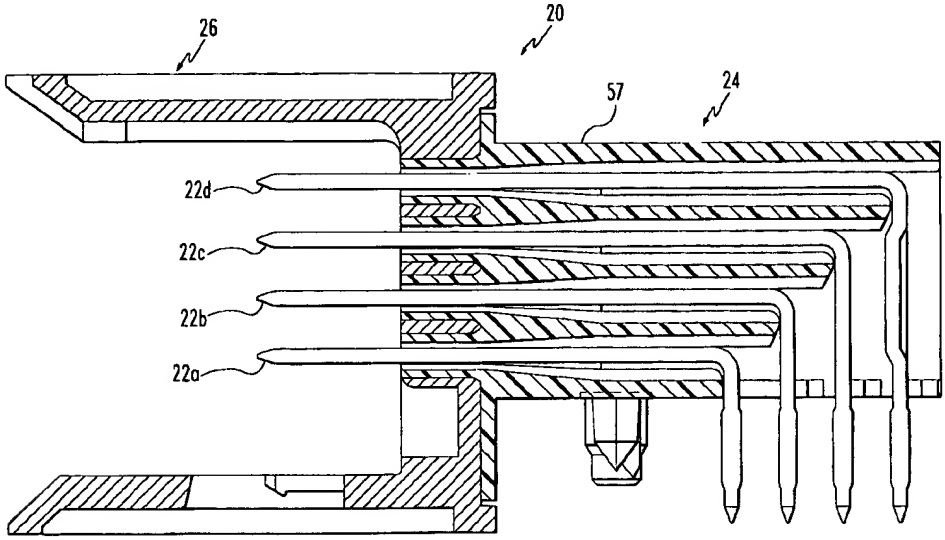
Primary Examiner—Gary F. Paumen
Assistant Examiner—Tho D. Ta
Attorney, Agent, or Firm—Brian J. Hamilla; M. Richard Page

[57] **ABSTRACT**

A right angle press fit connector employs a modular construction having a common terminal carrying press block that is associable with different types of shroud structures. The press block may include true positioned location structures for press fit tails. The true position structures may be integral with the press block. A cruciform shaped terminal insertion passage in the press block minimizes damage to the plating of the terminals and provides structural stiffness.

18 Claims, 14 Drawing Sheets



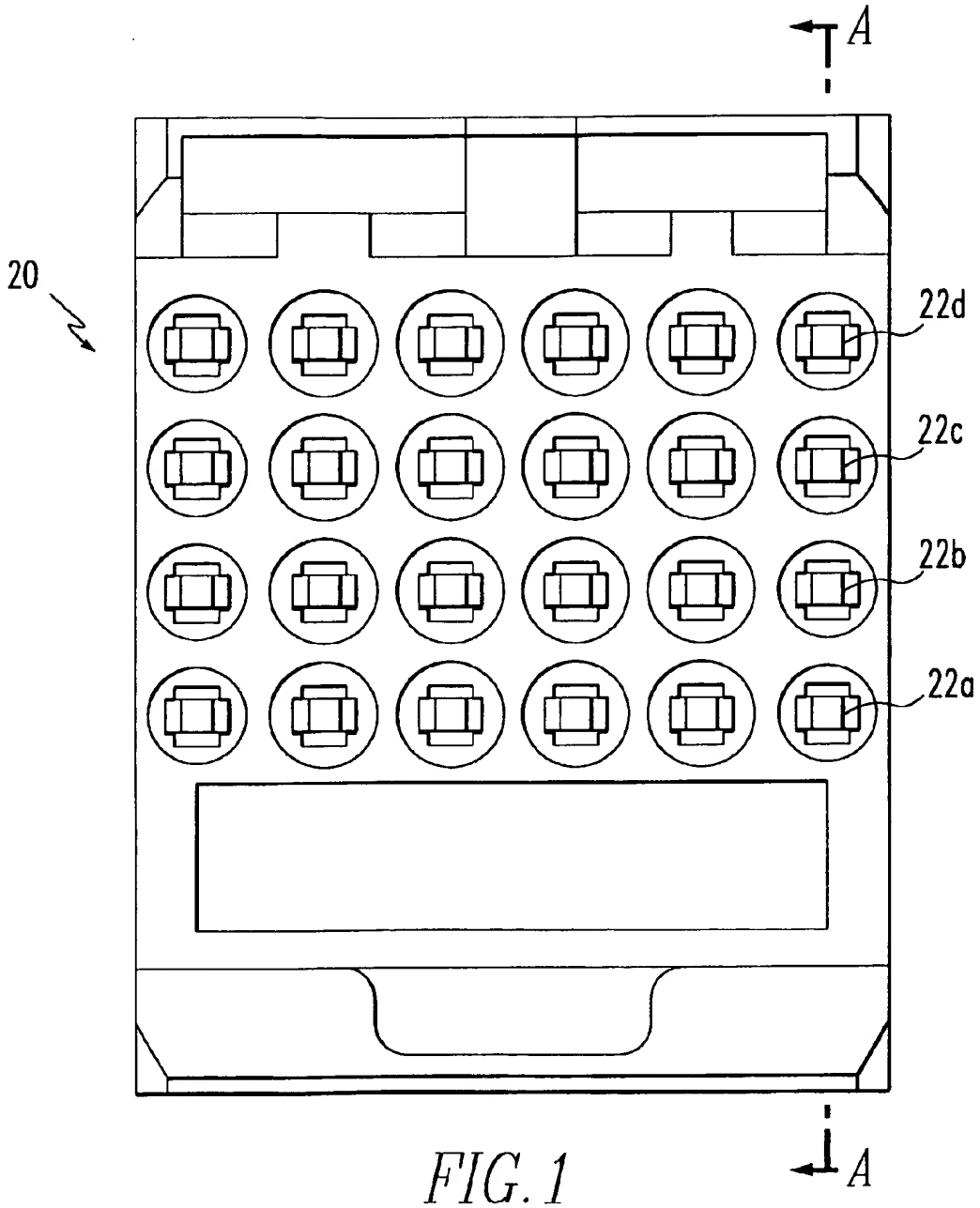


FIG. 1

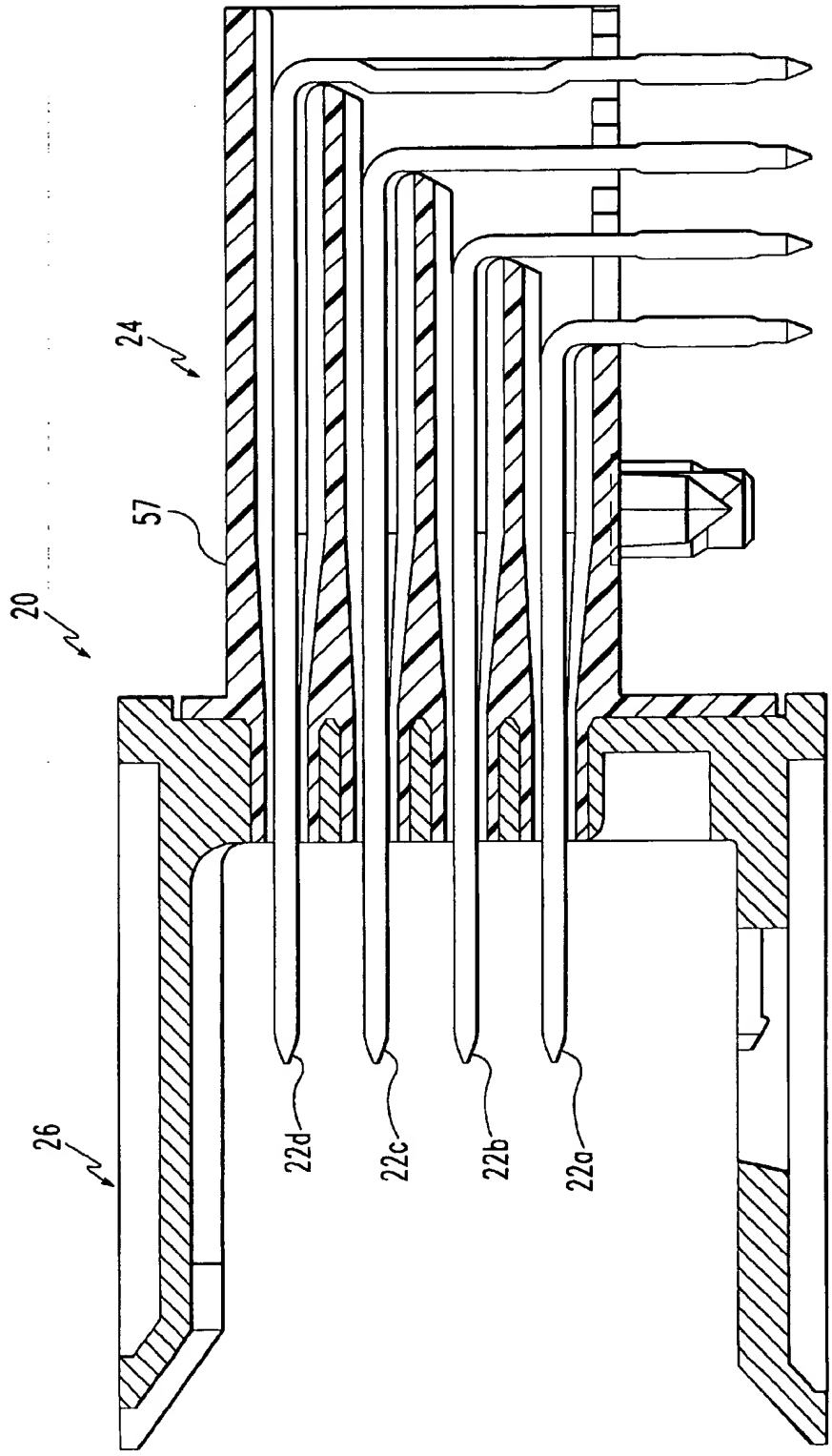


FIG.2

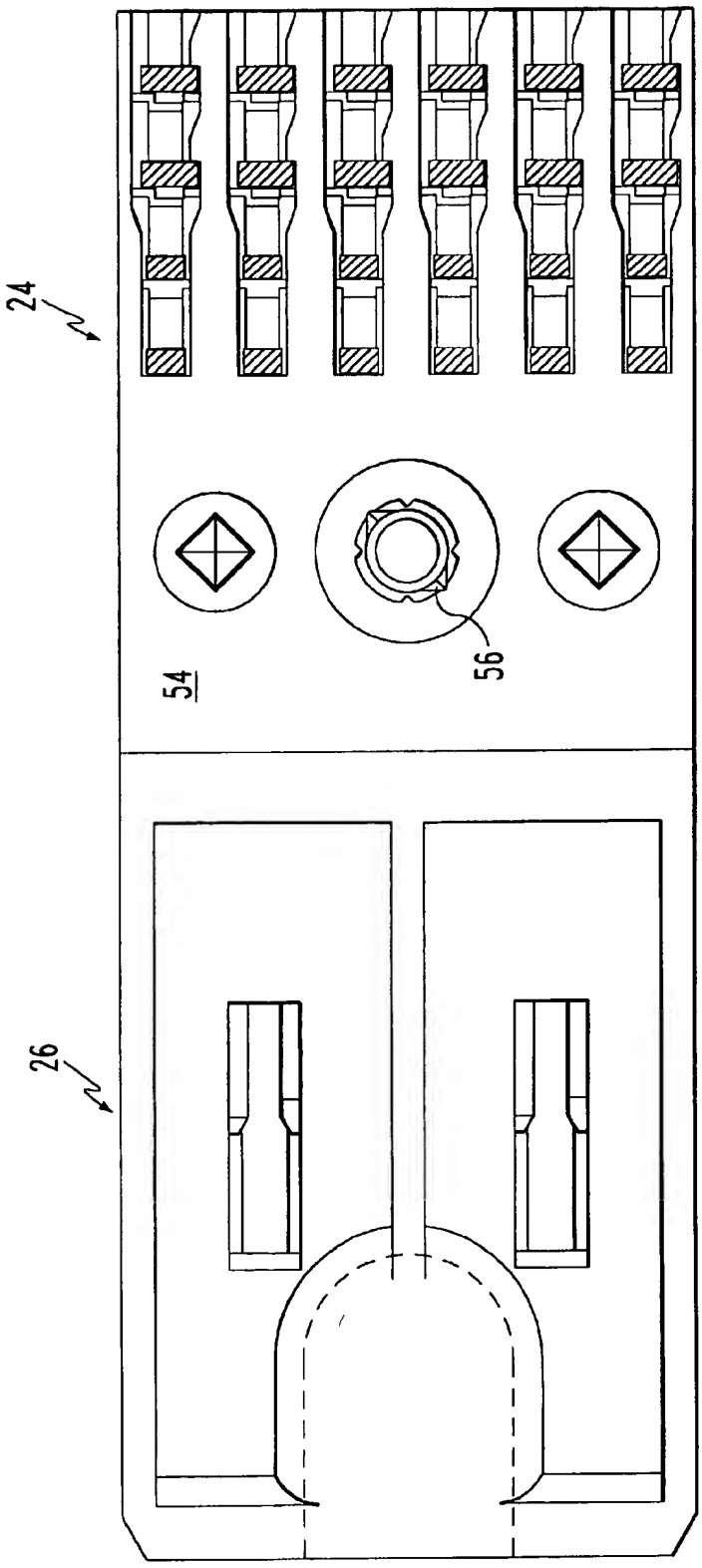


FIG. 3

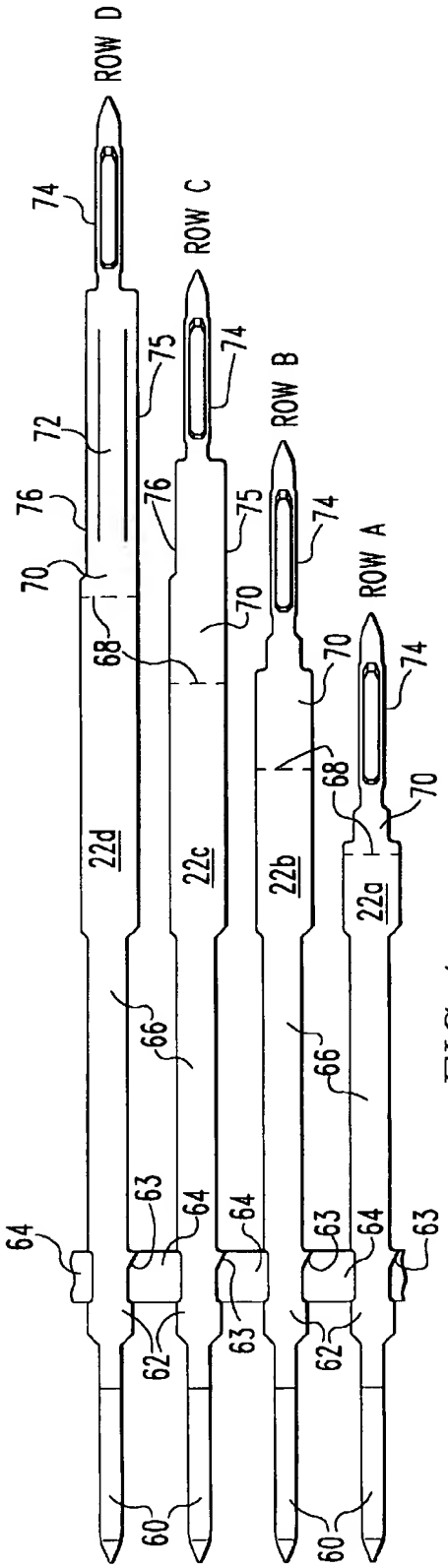

ROW D
ROW C
ROW B
ROW A
74
75
72
76
70
68
66
63
64
62
60
22d
22c
22b
22a

FIG. 4

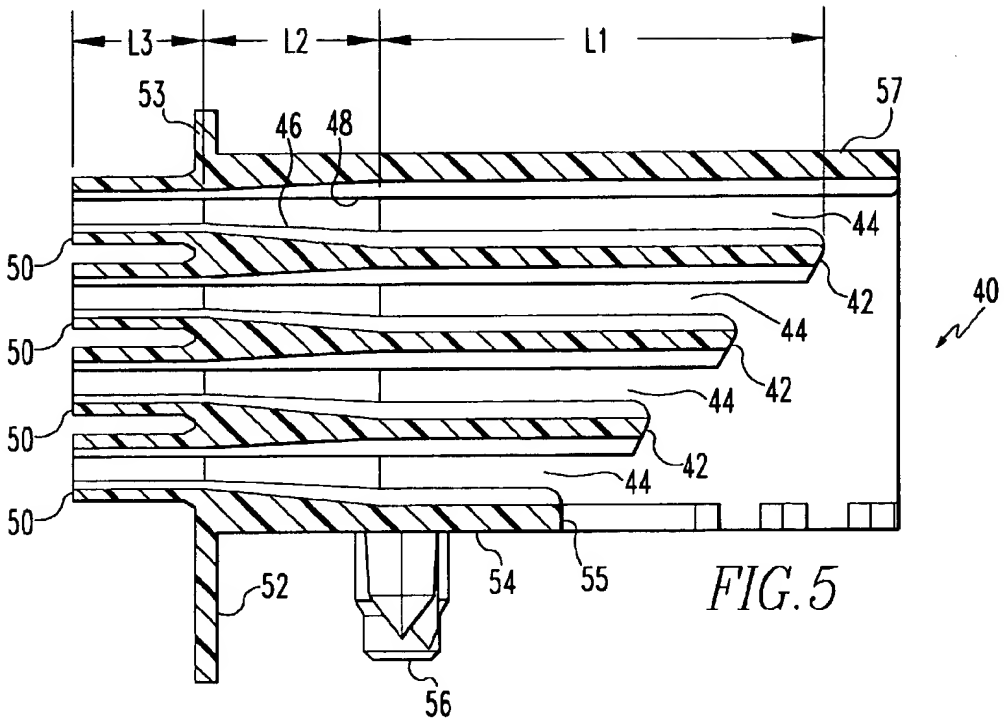

L3
L2
L1
53
46
48
57
44
50
42
40
44
50
42
44
50
42
44
50
52
54
55
56

FIG. 5

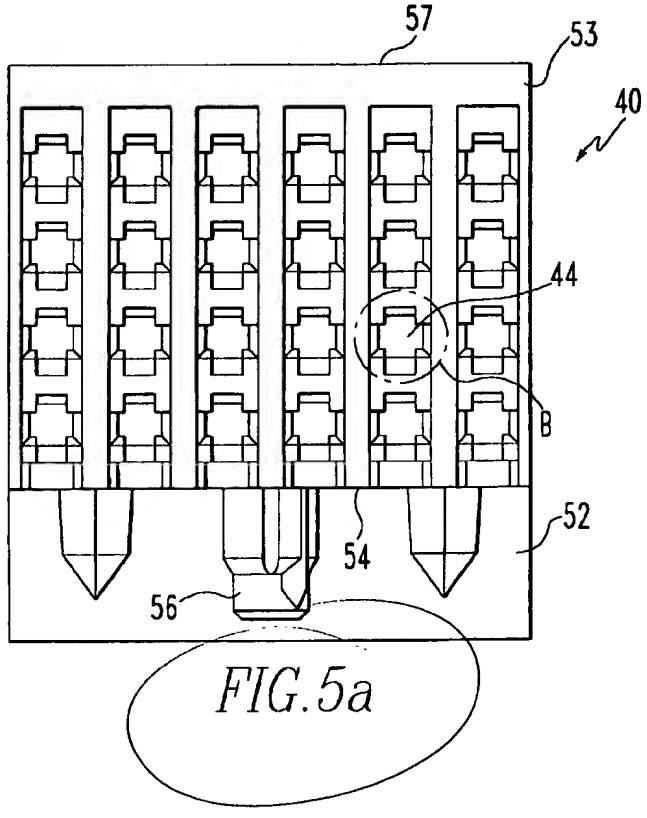

57
53
40
44
B
52
54
56

FIG. 5a

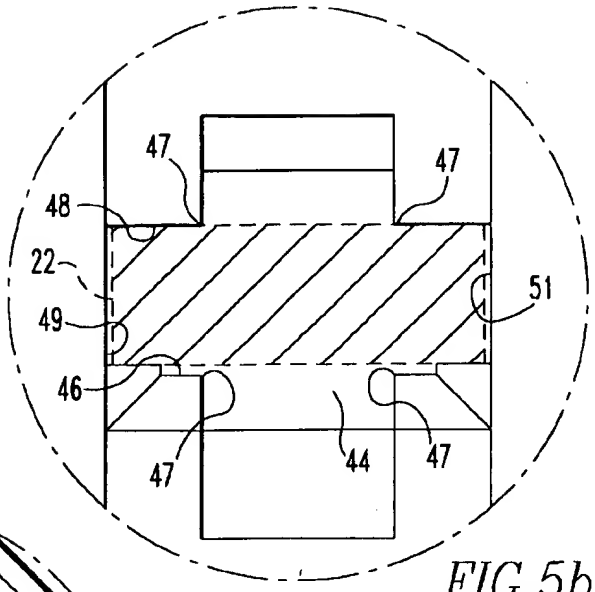


FIG.5b

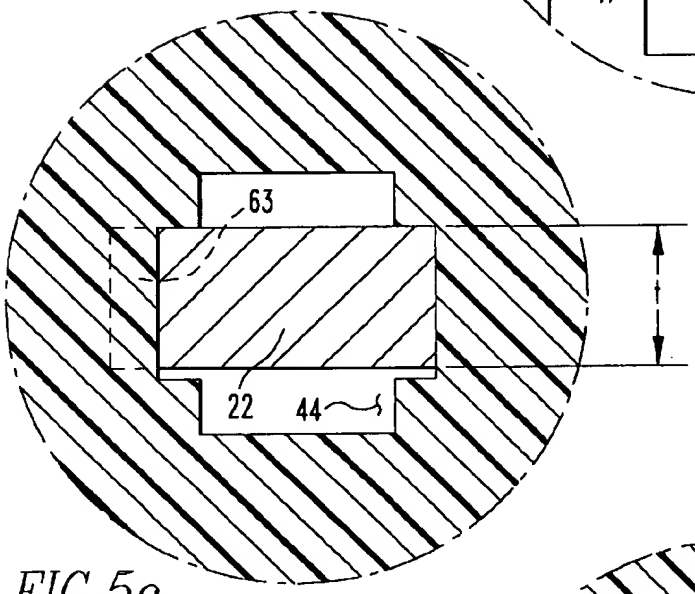


FIG.5c

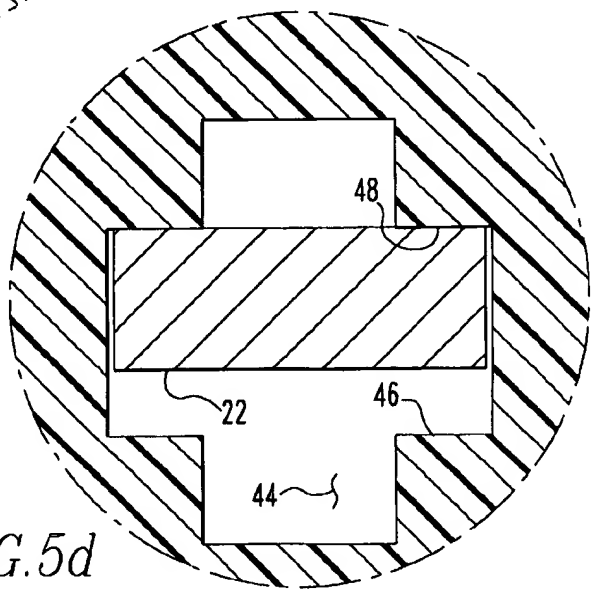


FIG.5d

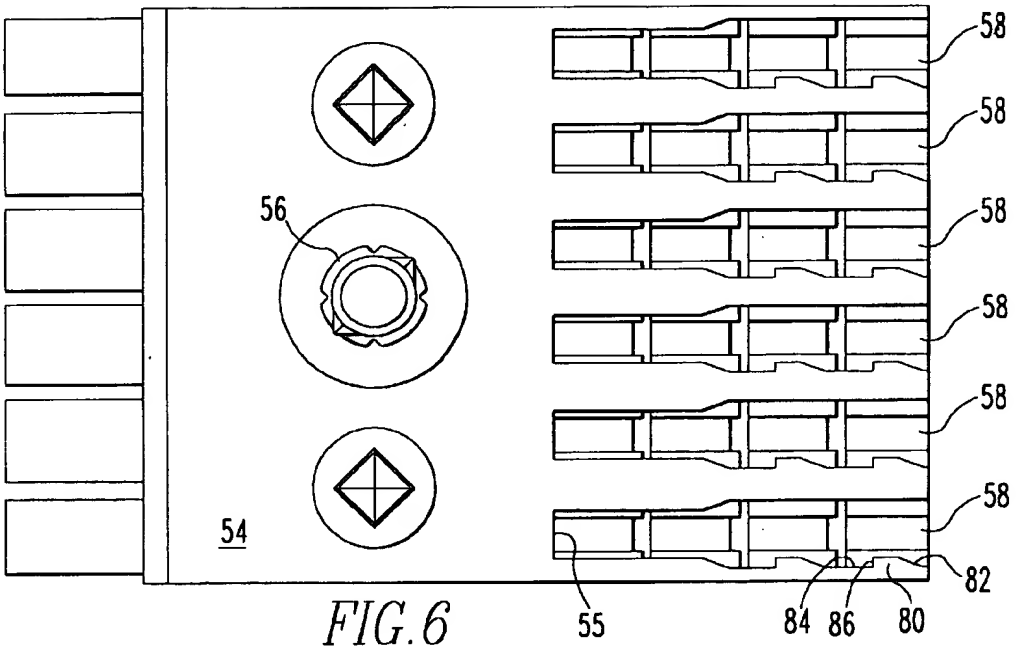


FIG. 6

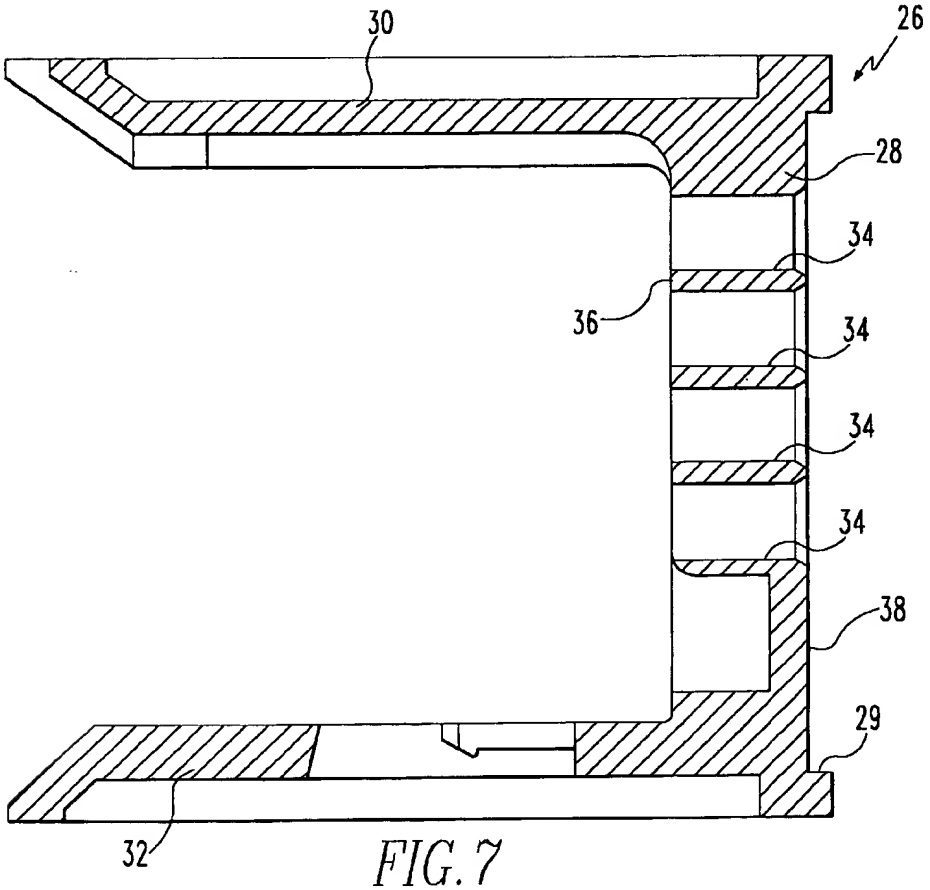


FIG. 7

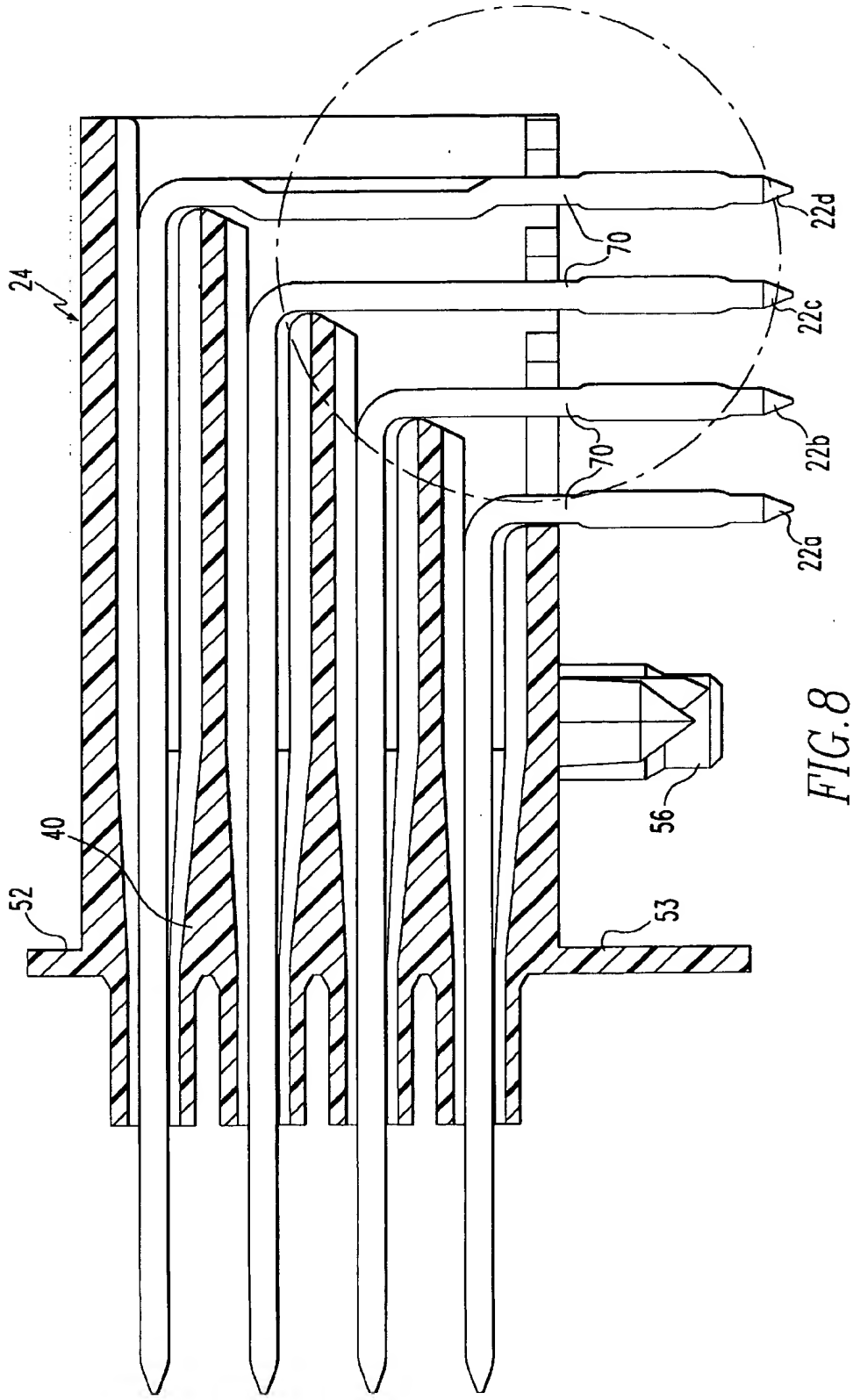


FIG. 8

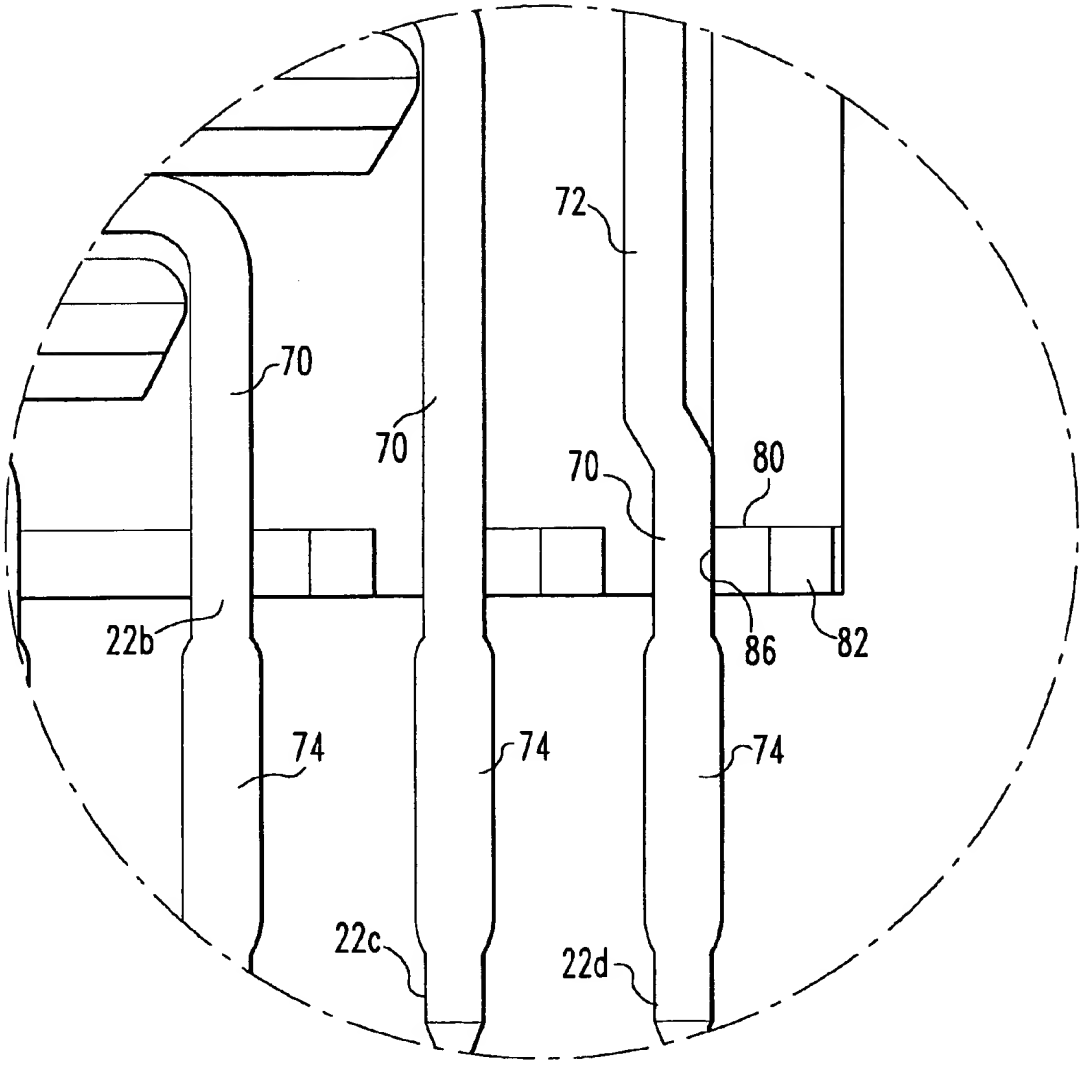


FIG.8a

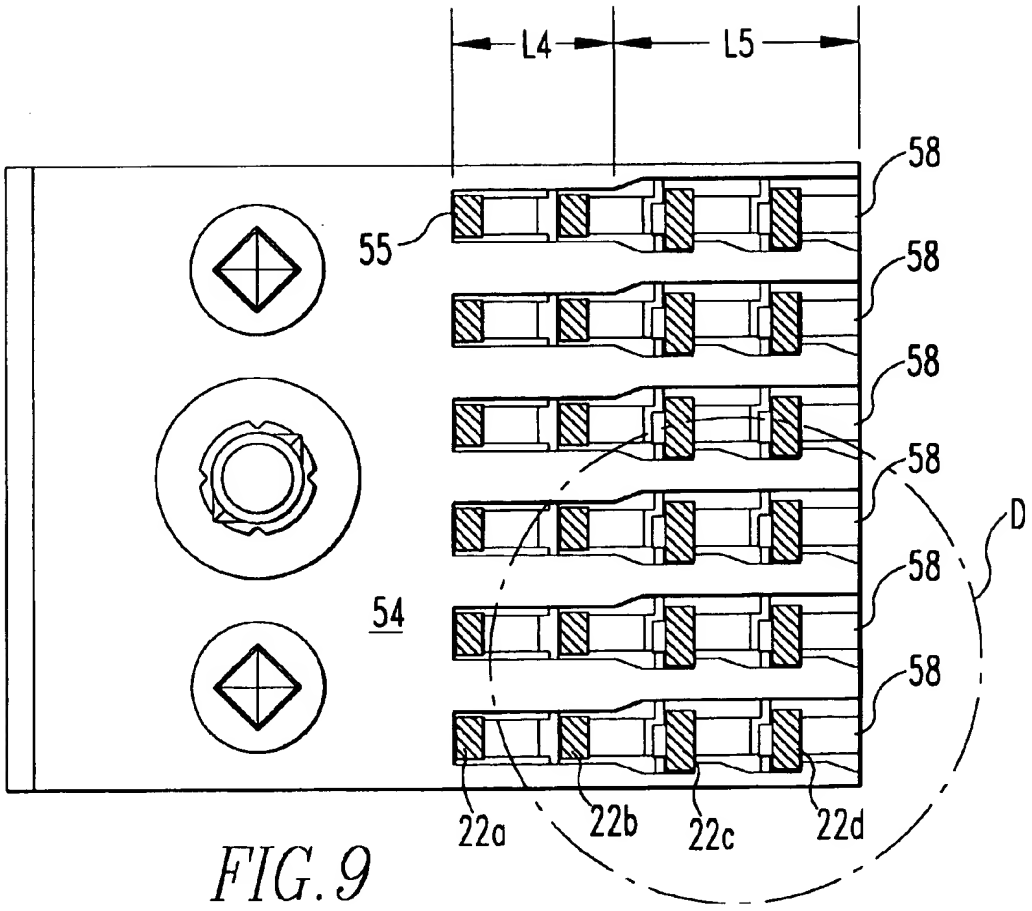


FIG. 9

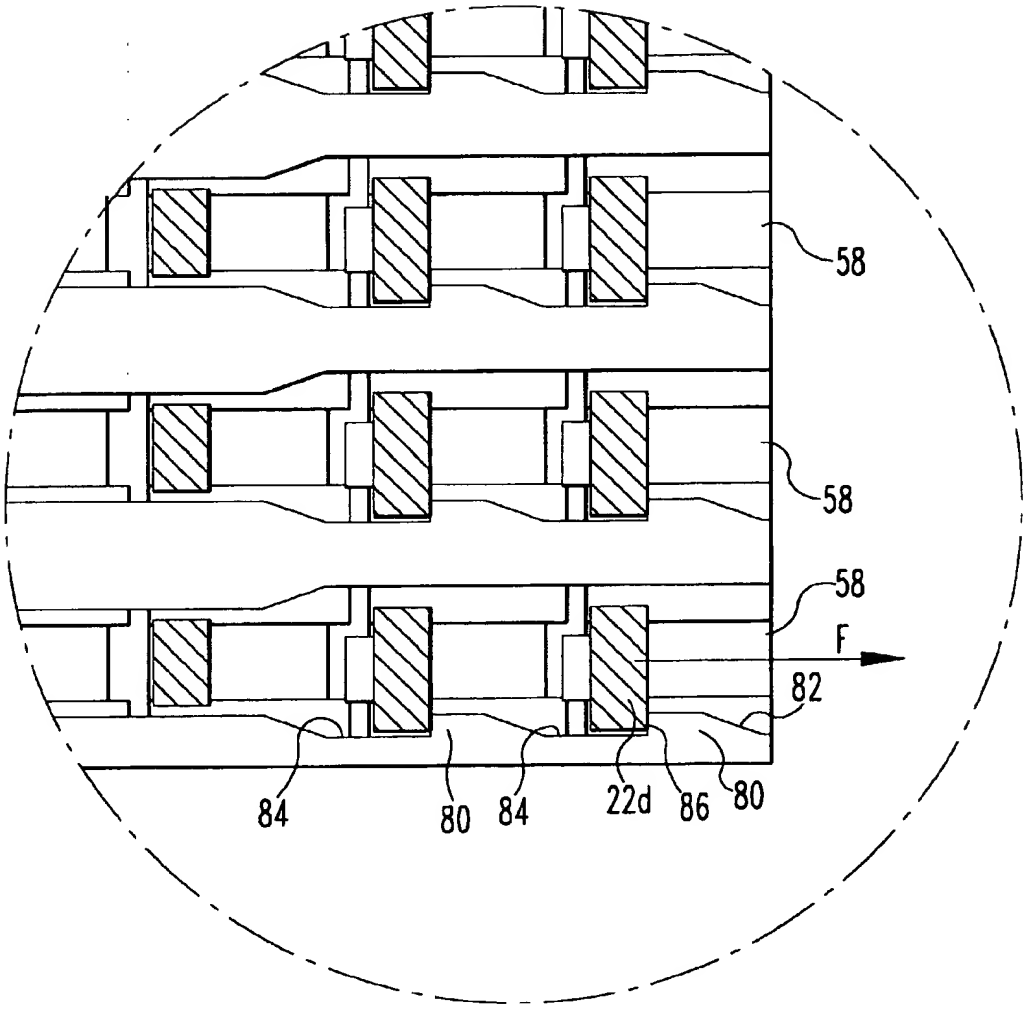


FIG. 9a

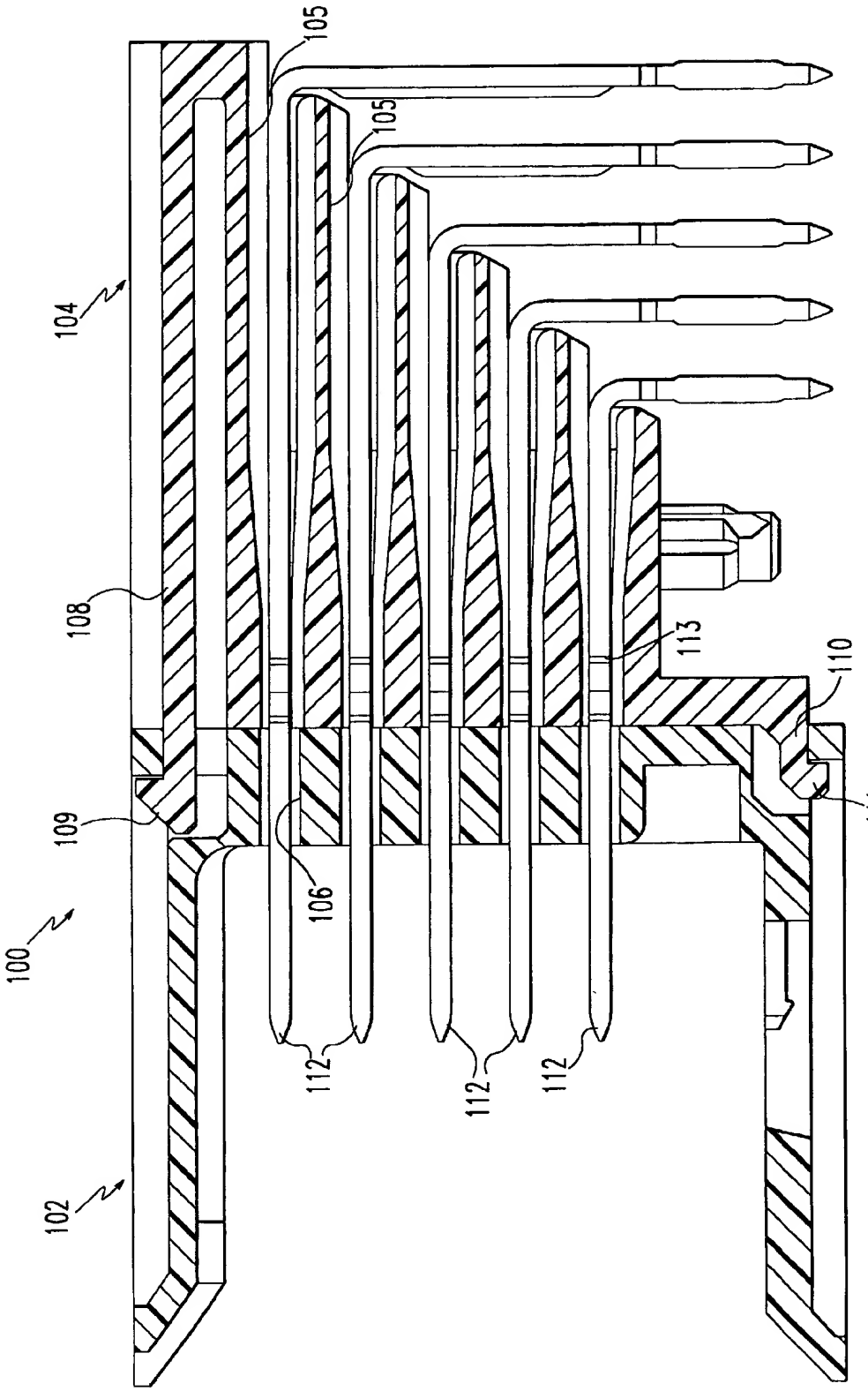


FIG. 10

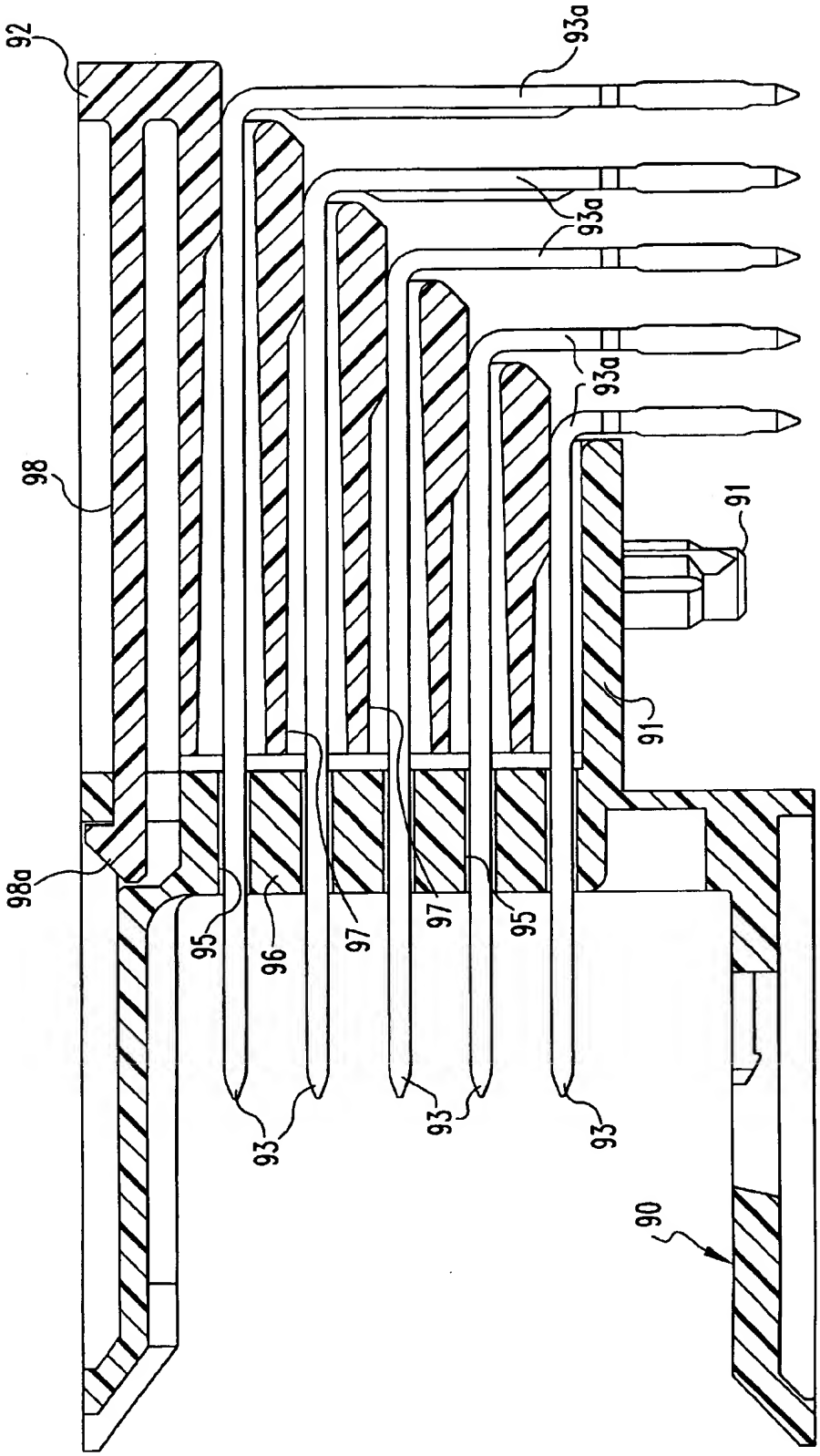


FIG. 11

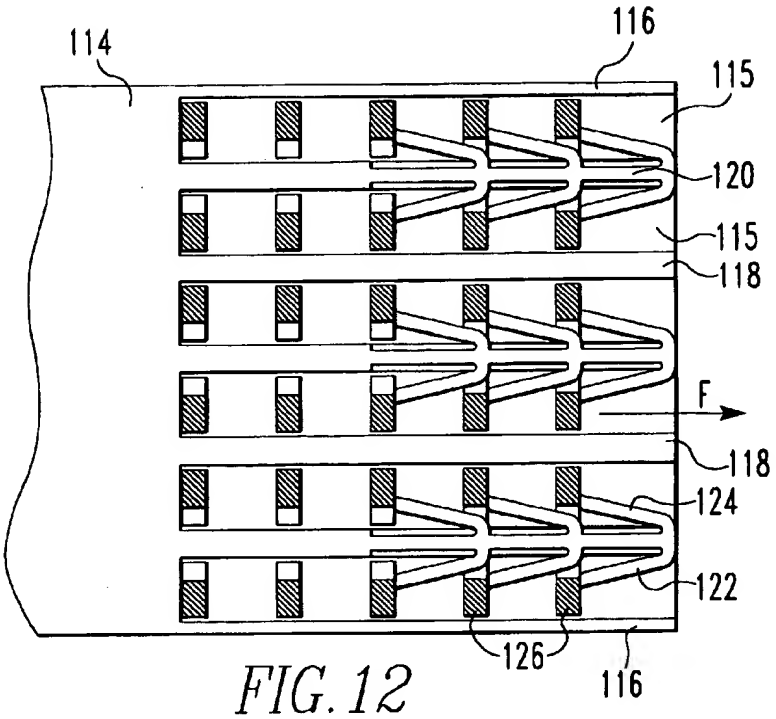


FIG. 12

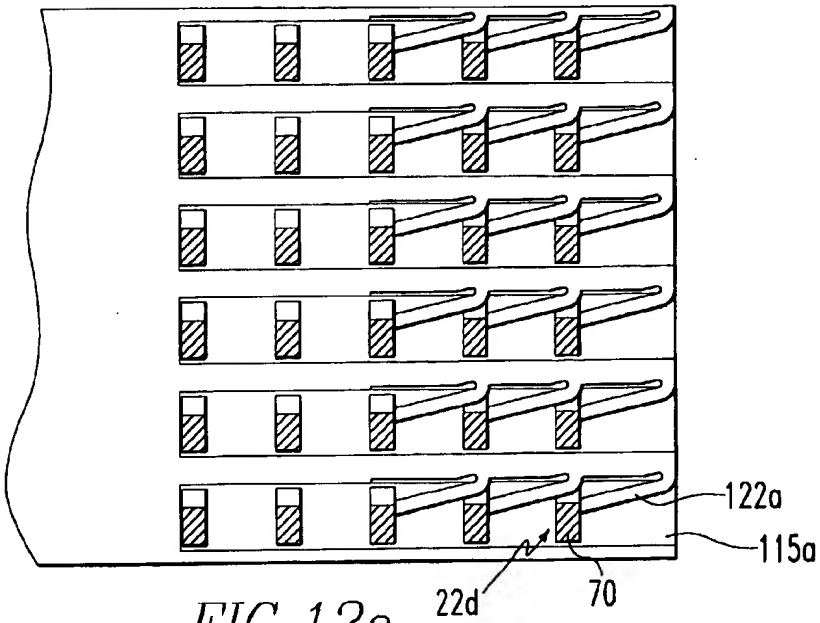


FIG. 12a

PRESS FIT CIRCUIT BOARD CONNECTOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to electrical connectors, especially to high density printed circuit board connectors. It particularly relates to right angle connectors that are secured onto the printed circuit board by press fitting.

2. Brief Description of Prior Developments

High density, press fit printed circuit board connectors as illustrated in U.S. Pat. No. 5,044,994 have been commercialized. The right angle header connector illustrated in this patent employs a single piece construction in which the pin terminals are secured in a one piece molded plastic housing. The housing comprises a pin retention body and forwardly extending top and bottom walls that form a shroud enclosing two sides of the pin field. As industry requirements for increased signal speed and improved isolation from electromagnetic interference (EMI) have evolved, the desirability for providing electrical shielding for these headers has increased. This need for enhanced electrical performance has occurred in the context of continuous pressure to maintain or reduce the production costs for such connectors.

PCT Application U.S. 96/04670 shows one approach for improving electrical performance of a vertical, high density pin header in which the connector body is formed as a one piece metal housing. The pin terminals of the connector are secured in a molded plastic insulative holder having sleeves surrounding the base of the pins to insulate the pins from the connector body. In this connector, the terminal tails are straight and are not bent as required for a right angle header.

Another factor that influences the overall cost of using such connectors is the ease and reliability of mounting them. This requirement is made difficult by the necessity of assuring that the press fit tails of the terminals of 30, 40, or more terminals, usually on a 2 mm×2 mm pitch, must be located according to very tight true position tolerances, so that the tails are not mispositioned during board mounting. Tight true positions tolerances are particularly difficult to achieve when the terminals are formed of a relatively thick, stiff material and/or when the vertical tails of the terminals are relatively long. In order to achieve such positioning, tail positioning wafers as shown in the above-identified U.S. Pat. No. 5,044,994 have been utilized. In another approach as illustrated in U.S. Pat. No. 5,593,307, a separate press block with tail bending features has been proposed. However, the need for providing true position tail location at low manufacturing costs is not fully satisfied by these approaches, because they either add additional cost or do not provide sufficient tail location.

SUMMARY OF THE INVENTION

This invention relates to a connector that employs an insulative carrier for holding terminal pins of a connector. Alternative insulative or conductive shroud sections can be associated with the carrier to form non-shielded or shielded headers, respectively.

The invention also relates to assuring true position location of press fit terminal tails. In this aspect of the invention, the terminal holding structure is provided with position stops to be engaged by terminal tails under pretension to assure longitudinal positioning. Lateral positioning direction is imparted by at least one side wall of a slot in which the tail is located.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a front elevational view of a pin header according to a first embodiment of the invention;

FIG. **2** is a side cross-sectional view of the connector shown in

FIG. **1** taken along line A—A of FIG. **1**;

FIG. **3** is a bottom view of the embodiment shown in FIG. **1**;

FIG. **4** is a top view of a set of contacts forming one column of terminals of the connector header shown in FIG. **1**, in an intermediate stage of manufacture;

FIG. **5** is a cross-sectional view of a press block prior to insertion of terminal pins;

FIG. **5***a* is a rear view of the press block shown in FIG. **5**;

FIG. **5***b* is an enlarged view of the area B of FIG. **5***a* including a sectioned portion of a terminal;

FIG. **5***c* is a cross-sectional view taken in zone L_3 of FIG. **5**;

FIG. **5***d* is a cross-sectional view taken in zone L_1 of FIG. **5**;

FIG. **6** is a bottom view of the press block shown in FIG. **5**;

FIG. **7** is a cross-sectional view of a shroud for use with the press block shown in FIG. **5**;

FIG. **8** is a cross-sectional view of the press block as shown in FIG. **5**, with pin terminals inserted and bent into final position;

FIG. **8***a* is an enlarged view of the circled area C of FIG. **8**;

FIG. **9** is a bottom view of the press block with terminals shown in FIG. **8**;

FIG. **9***a* is an enlarged view of the area D of FIG. **9**;

FIG. **10** is a cross-section of a second embodiment, wherein the shroud is latched onto the press block;

FIG. **11** is a cross-sectional view of a third embodiment, wherein the board mounting section is integral with the shroud; and

FIGS. **12** and **12***a* are bottom views of a press block section showing other types of terminal tail positioning structures.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As shown in FIG. **1**, a first embodiment of pin header **20** has, as is conventional, an array of pins **22***a*–**22***d* arranged in rows and columns. For illustrative purposes only (as other configurations are also used), the header is shown in FIG. **1** as having four rows (rows A–D) and six columns of pin terminals.

Referring to FIGS. **2** and **7**, the header **20** comprises two parts that are joined together, a press block **24** and a shroud **26**. As shown in FIG. **7**, the shroud **26** includes a base portion **28** and top and bottom walls **30** and **32**, respectively. The walls **30** and **32** project in a generally perpendicular fashion from base **28** and enclose the pin field on two sides. The base **28** includes a plurality of openings **34** extending from a front or mating interface side **36** to a rear side **38** of the base **28**. The openings **34** can be of any desired shape and, as shown, are substantially cylindrical. The shroud **26** can be formed of a molded insulative thermoplastic material or of a conductive material, such as a die cast zinc. An insulative plastic material is chosen when the shroud is not required to perform a shielding function. The shroud **26** can be formed of conductive material, or alternatively a metallized plastic material, when a shielding function is desired.

As shown in FIGS. **2** and **5**, the header **20** also includes a press block or carrier **24** that carries the pin terminals **22***a*–**22***d*. The press block **24** comprises a body **40** formed of an insulative material, such as a moldable thermoplastic. The body **40** has a plurality of passages **44** formed therein, corresponding in arrangement to the desired array of pin terminals. As shown in FIGS. **5***a*–**5***d*, each passageway **44** has a generally cruciform configuration. The cruciform shape of the passageway **44** provides a lower guide surface **46** (FIG. **5***b*) and an upper guide surface **48** for each of the terminal pins **22**. In the portion L_1 (FIG. **5**) of passage **44**, the surfaces are substantially parallel. In the portion of the passageway designated as L_2 in FIG. **5**, the lower guide surface **46** converges toward the upper guide surface **48**. In the front portion L_3 of the passageway, the vertical distance between surfaces **46** and **48** is slightly greater than the thickness t of the terminal **22** (FIG. **5***c*).

FIG. **5***b* is a view looking toward the front end of a passage L_1 with a terminal **22** positioned in the passage, from a point just to the left of a bending nick **68**. As shown in FIGS. **5***b* and **5***d*, the terminal is positioned against the upper guide surface **48**. When an insertion force is applied to the top of the press block, it is distributed to the tail sections of the terminals **22** through the surfaces **48** to push the press fit tails **74** into the circuit board. As shown in FIG. **5***c*, because the vertical height of the passage **44** in zone L_3 is just slightly greater than the thickness t of the terminal **22**, the vertical position of the pin portion **60** is located with a relatively tight tolerance. Barb **63** is shown in position to lock the terminal against retraction from the passage **44**.

The press fit block or carrier **24** includes a plurality of cylindrical bosses **50** that extend beyond the positioning flanges **52**, **53**. The outer diameter of the bosses **50** and the inner diameter of the openings **34** in the shroud **26** are dimensioned so that there is a substantial interference fit between the bosses and the openings when the press block **24** and shroud **26** are pressed together. This interference fit secures the press block **24** and shroud **26** together. The front surfaces of the flanges **52** and **53** preferably are engaged against the rear side **38** (FIG. **7**) of the base wall **28** of shroud **26**, to be received within the recess **29**.

The press block includes a substantially flat top wall **57**, adapted to receive a pressing tool for pressing a finished connector into a printed circuit board. The press block **24** also includes a bottom wall **54**, that is adapted to provide the board mounting interface of the connector with the printed circuit board on which the connector is to be mounted. A securing peg **56** depends from the bottom wall **54**. The bottom wall **54** also has a plurality of tail receiving grooves **58** (FIG. **6**) extending in generally parallel fashion and corresponding in number to the number of columns of the connector. The tail receiving grooves **58** include structures for maintaining lateral and longitudinal positioning of the tails of the terminals, that will be described in greater detail below.

Referring to FIG. **4**, each set of pin terminals **22***a*, **22***b*, **22***c*, **22***d* are preferably blanked from flat stock, for example, a beryllium copper sheet having a thickness on the order of 0.5 mm. The number of different length pins of each set corresponds to the number of terminal pins in each column of the connector. The shortest pin **22***a* is located on the lowest row of the header and the longest terminal **22***d* is located on the highest row of the header, with the terminals **22***b* and **22***c* being disposed sequentially in the intermediate rows. Each pin terminal **22** includes a contact or mating pin section **60** that is intended to cooperate with a receptacle contact of a mating connector. This section is usually plated to impart corrosion resistance. Each terminal **22** further includes a guide section **62** and locking barbs **63** or shoulders that are formed when the carrier portion **64** is removed to separate the terminals. Each terminal **22** also includes a horizontal tail portion **66**, which extends from the retention section **62** to a bending nick **68**. The bending nick is intended to promote initiation of bending of the terminal at the location of the nick. Each terminal **22** further includes a vertical tail portion **70** that terminates in a through hole portion, preferably a press fit section **74**. If the vertical portion **70** is relatively long, it may be provided with a reinforcing rib **72** formed in the portion **70** to impart additional column strength to resist bending upon insertion.

As shown in FIG. **4**, preferably the lowest and next to the lowest row terminals **22***a* and **22***b* respectively have vertical sections **70** that are substantially symmetrical about a longitudinal center line. However, the remainder of the terminals, such as terminals **22***c* and **22***d* have vertical sections that are unsymmetrical, arising from the fact that one edge **75** is substantially straight whereas the opposite edge **76** is relieved along the opposite sides. The purpose of the relief is to allow the tail section **70** to move laterally a small distance, so that it can move past true position stops in the form of abutments or fingers, that are later described.

Referring to FIG. **8**, a finished, completed press block **24** is shown after insertion of the terminal pins into the plastic body **40**. Prior to insertion, the terminals are rotated 90° about their axes from the orientation illustrated in FIG. **4**, so that the bending nicks **68** are located substantially horizontally, facing toward the bottom wall **54**. The terminals **22***a*–**22***d* are inserted longitudinally into the cruciform passages **44** to a position where the retention sections **62** are secured within the bosses **50** and the bending nicks **68** are located in general alignment with the shorter wall **42** of each of the passageways **44**. As each terminal is inserted along each passageway, **44**, its movement in the vertical direction is constrained by the upper and lower walls **46** and **48** and in the lateral direction by the side walls **49** and **51** (FIG. **5***b*). As the retention portion **62** enters the zone L_2 of the passageway the walls **46** or **48** help to position the terminal **22** in its final vertical position within each boss **50** as illustrated by the phantom position of terminal **22** shown in FIG. **5***c*. The barb **63** snags a side wall of the passage and prevents the terminal from moving rearwardly out of the passage. Preferably the terminals **22** are stitched into body **40** row by row, beginning at the lowermost row. The shroud **26** can be assembled to the press block body **40** before or after terminal stitching. The use of the cruciform passageway **22** minimizes damage to plating on the contact section **60** of the pin as the terminal is inserted into the press block body **40**. This results from the fact that only the interior corners **47** are likely to be engaged by the section **60** as the terminal is inserted. Although, the cruciform shape has been found effective and relatively easy to incorporate into tooling, any shape that provides opposed narrow projections projecting inwardly toward the center of the passage is believed to be useful for this purpose.

After insertion of the terminals **22** into the block **40**, each terminal is bent by appropriate tooling to form the vertical sections **70**. As the terminals are bent about the bending nicks **68** toward a vertical orientation, the vertical tail portions enter the tail slots or grooves **58** (FIG. **6**). For the lowest row terminals **22***a*, the lateral or side to side positioning of the press fit tail section is derived by the close relationship between the side edges of the fore portions L_4 of the tail grooves **58** engaging the side edges of the terminal. Longitudinal or end to end positioning is achieved

by positioning the tail against the end **55** of the slot. For subsequent terminals in each column, the true location features are somewhat different. When the vertical sections of these terminals are formed by bending, the bottom portions adjacent the press fit sections **74** enter into the tail slots **58**. The bent tails of the terminals **22***b*, **22***c* and **22***d* are located in the section L_5 of the groove. In the section L_5 (FIG. **9**) of each groove there is disposed a true position locating feature for retaining the press fit tails **74** in proper longitudinal location. As illustrated in FIGS. **8***a* and **9***a*, a preferred form of true location positioning structure comprises a series of abutments formed adjacent a succession of recesses **84** in the side wall of the slot **58**. At the junction between each recess **84** and each abutment **80**, a shoulder **86** is formed. Each abutment ideally includes a ramp section **82** that facilitates movement of the tail past the abutment. As the tail section of each terminal is bent, it enters an associated tail slot **58** and, depending upon its row location, engages one or more of the abutments **80** as it is bent. As previously described, the relieved areas or edges **76** on the vertical tails **70** allow the tails to move laterally in the slot **58** as the straight edges **75** encounter the abutments **80**. The tails are bent to a degree such that there is a residual amount of pretension in each tail that tends to bias the tail in the direction of arrow F (FIG. **9***a*). As a result, when the tooling for bending is withdrawn, each terminal tail section **70** has an inherent spring bias in the direction of arrow F. As a result, each tail section moves rearwardly and engages shoulder **86** of an associated abutment **80**. This provides longitudinal positioning for each of the tail sections. Lateral positioning is assured by having the edge **75** or each tail section located adjacent or slightly biased in torsion, against the recess **84**.

FIG. **10** shows a second embodiment of right angle press fit connector header **100** formed of two separate elements, a shroud **102** and a press block **104**. In this embodiment, the press block **104** includes one or more elongated upper latch arms **108** and one or more lower latch members **110**. The latches **109** and **111** of latch arms **108** and **110**, respectively are received in suitably configured openings in the base of the shroud **102** to secure the shroud **102** and press block **104** together. The press block **104** is formed of insulative material preferably a molded plastic. The terminals **112** are press fit into the block **104**. In this embodiment, the retention barbs **113** lock into the side walls of the passageway in the front portions of the passages **105**. If the header **100** is of a non-shielding type, the shroud **102** is formed of an insulative material, again preferably a molded plastic. In this case, the terminals **112** merely extend through openings **106** in the shroud. If the header **110** is to comprise a shielded header, then shroud **102** can be formed of a conductive material, such as a die cast metal or a metallized plastic. In this instance, it is preferable to included bosses (not shown) integrally formed on the press block **104**, similar to bosses **50** of the first embodiment, for electrically insulating each of the terminals on **112** from the shroud.

FIG. **11** illustrates a third embodiment of connector that has a shroud **90** and press block **92**. The shroud includes a circuit board mounting wall **91** that, preferably, is molded integrally with the shroud. The wall **91** includes hold down/location peg **94** for locating and holding the connector on a printed circuit board. In this embodiment, the pin terminals **93** are retained in the shroud **90** by retention within openings **95** in the base **96** of shroud **90**. After the pin terminals **93** are press fitted into the base **96** and while they are still straight, the press block **92** is slid onto the terminals, with the tail sections of the terminals received in passages **97**. One or more latch arms **98** are preferably integrally molded with press block **92** and carry a latch portion **98***a* that engages suitable openings in shroud **90** to secure the press block to the shroud. Thereafter, the vertical tails **93**a of the terminals are bent.

Referring to FIG. **12**, in a view similar to FIG. **6**, there is shown a second type of structure for fixing the true position of the press fit tail sections of the terminals. The structure shown in FIG. **12** is meant to accomplish substantially the same true position function as the arrangement shown in FIGS. **8***a* and **9***a*. In the arrangement shown in FIG. **12**, the bottom surface **114** of the press block includes a number of tail receiving slots **115** corresponding to the number of columns of terminals in the connector. The tail receiving slots **115** are formed between alternating stop walls **120** and either outside walls **116** or intermediate walls **118**. The stop walls **120** are formed with a plurality of successive flexible fingers **122** and **124**. As each terminal tail section is bent to a vertical position, it engages one or more of the flexible fingers **122**, **124** and urges them to a deflected position as the terminal passes. Once the terminal tail **126** passes by a resilient finger, the finger resiles toward the opposite side of the groove. As previously noted in connection with the first embodiment, each terminal tail is bent to a degree so that it retains a certain pretension in the direction of the arrow F. As a consequence, when the vertical tail **126** of a particular terminal passes the stop finger **122**, **124** closest to its final position, the finger moves toward an opposite wall of the groove **115** and is positioned so that its end surface engages the terminal **126** against its inherent spring bias, thereby providing longitudinal location for the press fit section. As shown in FIG. **12**, lateral positioning of the terminal tails is achieved by having one edge thereof engaging the surface of one of the walls **116**, **118**. Alternatively, arrays of fingers **122***a* can be disposed on one side of each of the slots **115***a*, as shown in FIG. **12***a*. This arrangement has the advantages of being somewhat easier to tool than the FIG. **12** embodiment and also allows the use of terminals that are completely symmetrical, even in the tail sections.

The foregoing embodiments yield manufacturing cost advantages arising from the fact that a single terminal bearing carrier or plus press block may be associated with a plurality of different types of shrouds to form a multiplicity of different header configurations. This simplifies tooling requirements and ultimately results in lower costs.

True positioning of the press fit tails of the right angle connector is achieved by incorporating the locating structure integrally into the terminal carrying press block. The tail true position location can be used for pin headers, as shown, but also with any type of terminal having a bent tail that must be positioned for circuit board insertion. The use of cruciform shaped terminal receiving passages results in improved protection of plating on the terminals and yields a relatively rigid press block structure.

While the present invention has been described in connection with the preferred embodiments of the various figures, it is to be understood that other similar embodiments may be used or modifications and additions may be made to the described embodiment for performing the same function of the present invention without deviating therefrom. Therefore, the present invention should not be limited to any single embodiment, but rather construed in breadth and scope in accordance with the recitation of the appended claims.

What is claimed is:

1. An electrical connector comprising:

a shroud having:

a base having a plurality of openings; and

at least one wall extending from the base;

a press block body formed of an electrically insulative material and comprising:

a surface for receiving a press tool,

a front section,

a rear section;

an array of terminal receiving passages, each passage extending from the front section to the rear section, and

a plurality of bosses;

a plurality of conductive terminals mounted on the press block body, each terminal having:

longitudinally extending axial portion received in one of said array of passages and in one of the bosses; and

a tail portion disposed at an angle to the axial portion and having a press fit section disposed at an end of the tail portion;

wherein each passageway has an upper surface arranged to impart a pressing force on said axially extending portion of the terminal received in the passageway, whereby a pressing force applied to the tool receiving surface is imparted to the tail portion of each terminal; and

wherein the bosses are received in the openings for securing the shroud onto the press block body.

2. A connector as in claim 1, wherein the bosses are secured in the openings with an interference fit.

3. A connector as in claim 1, wherein the upper surface of each passage comprises a pair of surfaces spaced transversely from each other and located to engage edge surfaces of said axial portion of a terminal received in the passage.

4. A connector as in claim 1, wherein each passage has a lower surface and the upper surface and the lower surface of each passageway converge from the rear section to the front section of the body.

5. A connector as in claim 1, wherein each passage includes narrow portions projecting inwardly toward a longitudinal axis.

6. A connector as in claim 1, wherein each passage has a substantially cruciform shape in cross section.

7. A connector as in claim 1, wherein the press block body includes tail retention structure for positioning said press fit sections of the terminal tails.

8. A connector as in claim 1, wherein each passage has a bottom wall and, at the rear section of the body, the top wall of each passage extends beyond the bottom wall of each passage.

9. A connector as in claim 8, wherein each terminal includes bend enhancing structure and the bend enhancing structure is positioned adjacent the rear end of the bottom wall of each passage.

10. A connector as in claim 1, wherein the press block body comprises a face adjacent said front, and the base of the shroud is positioned along said face and portions of the conductive terminals extend through said base.

11. A connector as in claim 10, wherein the press block body includes a securing element for securing said shroud on said face.

12. A printed circuit board-mounted electrical connect comprising,

an insulative body having a front section and a rear section;

a plurality of terminal receiving passages in the body extending from the front section to the rear section, each passage having a substantially cruciform shape in cross-section, an upper wall and a lower wall, the upper wall of each passage extending beyond the lower wall at the rear portion of the body;

a plurality of conductive terminals mounted on the body, each terminal having a longitudinally extending axial portion received in one of the passages and a tail portion extending transversely of the axial portion at the rear section of the body; each terminal having a notch located adjacent a rear end of the lower surface of the passage in which the terminal is received for enhancing the bending of the terminal, and each terminal having a press fit section disposed at a distal end of the tail portion for mounting to the printed circuit board; and

a positioning structure for positioning said press fit sections of the terminals relative to the body.

13. A connector as in claim 12, wherein each passage includes a plurality of spaced portions extending toward a longitudinal axis of the passage and forming parts of the upper and lower walls of the passage.

14. A connector as in claim 12, wherein the lower wall converges toward the upper wall, proceeding from the rear section toward the front section.

15. A connector as in claim 12, wherein the notch is a nick.

16. A connector as in claim 12, wherein the notch extends across the terminal.

17. An electrical connector comprising,

an insulative body having a front section and a rear section;

a plurality of terminal receiving passages in the body extending from the front section to the rear section, each passage having an upper wall and a lower wall, the lower wall converging toward the upper wall from the rear section towards the front section, the upper wall of each passage extending beyond the lower wall at the rear portion of the body;

a plurality of conductive terminals mounted on the body, each terminal having a longitudinally extending axial portion received in one of the passages and a tail portion extending transversely of the axial portion at the rear section of the body; each terminal having a bend enhancing feature located adjacent a rear end of the lower surface of the passage in which the terminal is received, and each terminal having a press fit section disposed at a distal end of the tail portion; and

a positioning structure for positioning said press fit sections of the terminals relative to the body.

18. A connector as in claim 17, wherein each passage has a substantially cruciform shape in cross-section.

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